



## **Limited Visual Dam Safety Inspection Summary Report**

**MA-054**

**Horner Reservoir**

**Maui, Hawaii**

**Prepared by:**

**U.S. ARMY CORPS OF ENGINEERS  
HONOLULU ENGINEER DISTRICT**

**STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES**

**May 2006**

Limited Visual Dam Safety Inspection Conducted on: 04 April 2006

**I. Purpose**

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

**II. Authority**

Inspections are authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statutes, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections are being conducted under joint agreements of the U.S. Army Corps of Engineers (USACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

**III. Scope**

Visual inspection will be made on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works would include the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may appear to be no immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

**IV. Limitations of Findings and Recommendations**

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

**V. Inspection Team**

<u>Organization</u>	<u>Name /Title</u>
U.S. Army Corps of Engineers	Troy O'Neal, P.E. Geotechnical Engineer
State of Hawaii, Dept. of Land and Natural Resources	Gordon Chong DNLR, Engineering Division
State of Hawaii, Dept. of Land and Natural Resources	Gary Tau'a DNLR, DOFAW
USDA, Natural Resource Conservation Service	Ranae Ganske-Cerizo
West Maui Land Co. (Present as Observer)	Dave Minami

**VI. Owner's Representatives Present**

Kaanapali Farm Services, Inc., aka Pioneer Mill Company, LLC	Robbie Vorfeld
---	----------------

**VII. Summary Report Team**

<u>Organization</u>	<u>Name</u>
U.S. Army Corps of Engineers	Derek Chow Bill Empson
State of Hawaii, Dept. of Land and Natural Resources	Denise Manuel Edwin Matsuda

**VIII. Dam Type**

The dam appeared to be an earthen embankment dam.

## IX. Dam Classification

The current hazard classification of this dam is: High

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Most likely small but insufficient information is available to inspectors to make a determination.

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

## X. Summary of Inspection

Condition Rating Criteria: The conditional terms in this report are used to generally describe the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

**A. General appearance:**

The dam is unique in that the dam consisted of two adjoining reservoirs whereas the southern reservoir was roughly 2-3 times larger in size than the northern reservoir. Further, in 1988 the southern reservoir downstream slope breached due to piping along the conduit from the outlet. Although no one was seriously injured, the dam owners took steps to build a berm to bisect and keep the northern reservoir in operation. The breach area was also replaced. Both sections were reported to be soil and rolled in with a tracked bulldozer. Additionally, the outlet works for the remaining reservoir was plugged and a siphon system was installed and piped over the dam slope. The intakes consist of an 8-inch pipe from a hillside collection system and another more prominent intake channel was flowing from uphill drainage at the time of inspection. An uncontrolled spillway (flowing) was located along the north edge of the remaining reservoir. The reservoir dam was approximately 30 feet tall and appears to have a significant drainage area.

**Findings and Corrective Actions:**

- a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- b. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- c. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- d. Routine inspection logs were not inspected.
- e. Dam owners shall provide for routine inspection of the dam.
- f. The dam did not appear to be maintained on a regular basis.
- g. Access to site appears to be satisfactory.
- h. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- i. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- j. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
- k. Power / Communication: There were no communication systems observed on this reservoir.

**B. Access / Security:**

Access to the dam was accomplished via a County roadway and dirt road. A four-wheel drive vehicle was required to access the site.

Security issues: Access to the dam is unrestricted.

**C. Intake Works: (Satisfactory)**

The intake ditch has one 8-inch PVC pipe that can be shut off with a valve to divert drainage flow. Additionally, a ditch/flume (5' by 1' and is rectangular in shape) lined with rock was located to the upstream east end of the reservoir.

Findings and Corrective Actions:

- a. The intake works were not tested.
- b. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.

**D. Reservoir: (Fair)**

The reservoir level was approximately 1267.5 feet at the time of the inspection based on spillway invert, and the normal operating level is 1267.5 feet. A staff gage did not exist. Typically the spillway is always flowing.

Findings and Corrective Actions:

- a. The reservoir appeared to be in fair to poor condition and requires corrective action.
- b. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.

**E. Upstream Slope: (Fair)**

The upstream slope was 1 on 1 and had no protection. Some erosion was observed with loose soil with little vegetation from wave action erosion at the west corner of the reservoir. No sinkholes were observed.

Findings and Corrective Actions:

- a. The upstream slope appeared to be in fair to poor condition and requires corrective action.
- b. Slope protection needs maintenance or repair.
- c. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

**F. Crest: (Satisfactory)**

The dam crest was approximately 25 feet wide, consisted of soil with scattered weeds and was accessible by vehicle.

Findings and Corrective Actions:

- a. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- b. Access along the crest was satisfactory.
- c. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

**G. Downstream Slope: (Fair)**

The downstream slope was approximately 3/4 on 1. There was no access other than on foot to the downstream slope and toe due to heavy overgrowth of brushes and mature trees. Sinkholes were not visible on the downstream slope. Seepage was not visible on the downstream toe.

**Findings and Corrective Actions:**

- a. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- b. The downstream slope was not visible due to high grass and bush visual inspection. Clear high vegetation and maintain low to enable easy visual inspection.
- c. Tree(s) were observed on the downstream slope. Trees have been identified as the probable cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstruction the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- d. The slope was very steep, around a 1 on 1 slope; further study is required to verify slope stability.

**H. Abutments / Toe: (Fair)**

The abutments and toe were not entirely visible or identifiable due to heavy vegetative growth.

**Findings and Corrective Actions:**

- a. The abutments/toe appeared to be in fair to poor condition and requires corrective action (heavy growth).
- b. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- c. Tree(s) were observed along the abutment/toe. Trees have been identified as the probable cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstruction the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

**I. Outlet Works: (Satisfactory)**

The outlet consisted of a 12" diameter (siphon condition) PVC pipe with a valve. No seepage was observed at the time of inspection.

Findings and Corrective Actions:

- a. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

**J. Spillway: (Satisfactory)**

This spillway dimension was 7 feet in wide consisting of a rock-lined channel. The spillway approach was clear and no erosion was observed near the spillway.

Findings and Corrective Actions:

- a. The spillway appeared to be in satisfactory condition, no corrective actions are required at this time.

**K. Down Stream Channel: (Unknown)**

The down stream channel is a defined drainage-way. The items along the stream bank were not inspected.

Findings and Corrective Actions:

- a. The downstream channel was not inspected, as it was not accessible.

**XI. Additional Comments:**

Based on visual observations and discussion of operational procedures of the dam, there is no immediate threat to the safety of the dam at this time.

Heavy growth needs to be removed to promote visual inspection of slopes.

Half of the reservoir was cutoff by a placing berm (with bulldozer) after failure of downstream slope due to conduit piping in 1988. The integrity of the berm appears satisfactory but should be further evaluated.



## PHOTOGRAPHS

MA-054 Horner Reservoir

## MA-054 Horner Reservoir



054 View of upstream end of reservoir in vicinity of intakes



## MA-054 Horner Reservoir



054 Plugged and abandon outlet downstream of reservoir.



## MA-054 Horner Reservoir



054 Abandoned dam standing on bisecting berm

## MA-054 Horner Reservoir



054 View of abandoned reservoir standing on replaced breached section.



## MA-054 Horner Reservoir



054 View of downstream slope from reservoir.



## MA-054 Horner Reservoir



054 View of downstream slope from reservoir.



## MA-054 Horner Reservoir



054 View of crest looking downstream, note trees on down slope of dam.



## MA-054 Horner Reservoir



054 View of inlet pipe into reservoir from modified inlet structure.



## MA-054 Horner Reservoir



054 View of one inlet with PVC modifications.



## MA-054 Horner Reservoir



054 Inlet (stream) from diversions upslope of reservoir.



## MA-054 Horner Reservoir



**054** Siphon outlet downstream - View of outlet siphon (12-inch diameter) modification after breach.

## MA-054 Horner Reservoir



054 Siphon valve downstream crest - View of siphon valve works and gages located at downstream crest.



## MA-054 Horner Reservoir



054 View of uncontrolled earth\rock spillway (flowing).



## MA-054 Horner Reservoir



054 View of upslope and crest looking to left end of dam.



## MA-054 Horner Reservoir



054 Upstream View of breached half of reservoir no longer in service.

## **FIELD INSPECTION SHEETS**

Dam ID: MA-0054

HORNER RESERVOIR

## Vulnerability Index:

Extreme	High	Moderate	Low
1	2	3	4

Inspection No:

Date: 4/4/06

**STATE OF HAWAII - DLNR**  
**DAM SAFETY INSPECTION SHEET**

Inspection Type: Visual Dam Safety Inspection

## Persons Present

## Affiliation

## Phone Number

TROY O'NEAL  
 GORDON CHONG  
 GARY TAV'A  
 ROBBY VORFELD  
 Ranae Ganske - Cerizo

US Army Corps of Engineers  
 DLNR  
 DLNR  
 PIONEER CO.  
 USDA - NRCS

**Weather Condition:** ☐ Rain previous day ☐ Rainy ☐ Drizzle / Mist ☐ Cloudy/Overcast ☒ Partly Cloudy ☐ Sunny ☐ Dry

Comments:

**1. General:** (Information currently on file, update as required)

Dam/Res. Name	HORNER RESERVOIR		
Owner	Kaanapali Farm Services, Inc. aka/ Pioneer Mill Company, LLC (C023)		
Owner Contact	Mr. Robbie Vorfeld	Owner Ph.	
Lessee		Lessee Ph.	
O & M Contractor		O & M Ph.	
Nearest Town	PUUKOLII	Latitude	20.9283° (decimal)
County	MAUI	Longitude	156.6517° (decimal)
Tax Map Key(s)	(2)4-4-004:001 & 013		

Dam Status	A:	Hazard Potential	H:	Dam Size	
Year Completed	1926	Dam Length	1100 ft.	Dam Height	30 ft.
Normal Storage	71 ac.ft.	Max. Storage	88 ac.ft.	Max. Surface Area	5.9 ac.
Drainage Area	0.06 mi.	Spillway Type		Max. Spillway Q	1000 cfs

Owner owns land under dam facility:

Emergency Action Plan on file with the Department: NO

Reports on file with the Department: Oct 1998 = Dam Safety Inspection, RM Towill Corp.  
 May 1980 = Army Corps of Engineers, Initial Dam Safety Inspection / Survey (1)

**2. Questions for Owner's Rep.:**

	Yes	No	Unknown	Comments
Construction Plans Available	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Site / Facility Map	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Operation & Maintenance Manual	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Emergency Action Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Modifications / Improvements	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	BERM BUILT TO BISECT RESERVOIR AFTER BREAK, <del>ON</del> SPORADIC, HIGH RAIN EVENTS
Conduct Routine Inspections	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Conduct Routine Maintenance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Vehicle access to site	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input checked="" type="checkbox"/> Requires 4-Wheel Drive
Access during heavy rains	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input checked="" type="checkbox"/> Requires 4-Wheel Drive
Access when spillway is flowing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input checked="" type="checkbox"/> Requires 4-Wheel Drive
Other Studies Conducted	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Phase I <input type="checkbox"/> Phase II <input type="checkbox"/> Hydraulics <input type="checkbox"/> Stability <input type="checkbox"/> Hazard <input type="checkbox"/> Seismic <input type="checkbox"/> Other: _____
Incident History	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Breached <input type="checkbox"/> Overtop <input type="checkbox"/> Slide <input type="checkbox"/> Down stream Flooding <input type="checkbox"/> Other: _____
Reservoir's Current Use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Sediment <input checked="" type="checkbox"/> Irrigation <input type="checkbox"/> Recreation <input type="checkbox"/> Flood Control <input type="checkbox"/> Drinking Water <input type="checkbox"/> Power Generation <input type="checkbox"/> Other: _____

**Findings and Corrective Actions:**

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☒ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☒ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☒ f. Routine inspection logs were not inspected.
- ☒ g. Dam owners shall provide for routine inspection of the dam.
- ☒ h. The dam did not appear to be maintained on a regular basis.
- ☒ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☒ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☒ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☐ o. \_\_\_\_\_

**Additional Requirements:**

The following investigative study(s) are:

Required Recommended

- |                          |                          |  |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Phase I Study  |
| <input type="checkbox"/> | <input type="checkbox"/> | Phase II Study (Including <input type="checkbox"/> Seepage <input type="checkbox"/> Hydrology/Hydraulics <input type="checkbox"/> EAP) |
| <input type="checkbox"/> | <input type="checkbox"/> | Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity)  |
| <input type="checkbox"/> | <input type="checkbox"/> | Stability Analysis   |
| <input type="checkbox"/> | <input type="checkbox"/> | Seismic Analysis   |
| <input type="checkbox"/> | <input type="checkbox"/> | Hazard Classification  |
| <input type="checkbox"/> | <input type="checkbox"/> | Other: _____   |

Dam ID: MA-0054  
HORNER RESERVOIR

Inspection No: \_\_\_\_\_  
Date: \_\_\_\_\_

**Physical Dam Features:** (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

**3. Reservoir:**

Level during inspection 1267.5 ft per \_\_\_\_\_ (gage / ~~other~~) SPILLWAY INVERT

Normal Operating Level/Range 1267.5 ft per \_\_\_\_\_ (gage / other)

Description: \_\_\_\_\_

Typical Operation ☒ Spillway always flowing ☐ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms  
☐ Other: \_\_\_\_\_

Sinkhole in Res.: ☐ # Observed: \_\_\_\_\_ Size: \_\_\_\_\_ by \_\_\_\_\_ in. Deep ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Staff Gage: Description: NONE

**Findings:**

- ☐ a. The reservoir was not inspected.
- ☐ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

**Corrective Actions:**

- ☐ e. The staff gage needs maintenance and/or repair. Description: \_\_\_\_\_
- ☒ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
- ☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
- ☐ h. \_\_\_\_\_

**4. Intake Works Description:**

☒ Number of Intakes 2  
☒ Intake Culvert / Pipe  
Size: 8 in. ☐ DIP ☐ Corrugated Metal ☒ PVC ☐ HDPE ☐ Concrete ☐ Other \_\_\_\_\_  
Control: ☐ Gate ☒ Valve ☒ Flow can either be Shut off or Bypassed  
From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☒ Other TUNNEL

☒ Ditch / Flume  
Dimension: 5' x 1' (Size x Depth) Shape RECTANGULAR  
Surface: ☐ Dirt ☐ Wood ☐ Concrete ☒ Lined w/ ROCK  
Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed  
From: ☐ Stream Diversion ☐ Pump ☒ Reservoir ☐ Other \_\_\_\_\_

**Findings:**

- ☐ a. The intake works were not inspected.
- ☒ b. The intake works were not tested.
- ☒ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

**Corrective Actions:**

- ☐ f. The intake works needs maintenance and/or repair. Description: \_\_\_\_\_
- ☐ g. \_\_\_\_\_

Dam ID: MA-0054  
HORNER RESERVOIR

Inspection No: \_\_\_\_\_  
Date: 4/3/06

**5. Upstream Slope:**

(Typical Slope  $\pm$  1 : 1)

Slope Protection: ☒ None ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner \_\_\_\_\_ ☐ Other: \_\_\_\_\_

☐ Defect in Protection: Description: \_\_\_\_\_

Erosion: ☒ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☐ None Observed

Description: WAVE ACTION EROSION @ WEST CORNER

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Sinkholes: ☐ # Observed: \_\_\_\_\_ Size: \_\_\_\_\_ and \_\_\_\_\_ Depth ☐ Not Visible ☒ None Observed

Description: \_\_\_\_\_

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☐ Trees # \_\_\_\_\_ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: \_\_\_\_\_

**Findings:**

- ☐ a. The upstream slope was not inspected.
- ☐ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The upstream slope appeared to be in fair to poor condition and requires corrective action. (WAVE ACTION WEST END)
- ☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function.  
Urgent corrective action is required.

**Corrective Actions:**

- ☒ e. Slope protection needs maintenance or repair. Description: WEST CORNER (WAVE ACTION)
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair.  
Description: \_\_\_\_\_
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause.  
Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause.  
Repair and monitor the area.
- ☒ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ k. \_\_\_\_\_

Dam ID: MA-0054  
HORNER RESERVOIR

Inspection No: \_\_\_\_\_  
Date: 4/4/06

**6. Crest:**

Approximate Crest Width: 25'

Access: ☐ None ☐ Walking Path ☒ Roadway, Surface / Width / Usage: DIRT / 20' / YES

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed

Description: \_\_\_\_\_

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed

Description: \_\_\_\_\_

Sinkholes: ☐ \_\_\_\_\_ in. Wide x \_\_\_\_\_ in. Long x \_\_\_\_\_ in. Deep ☒ Not Visible ☐ None Observed

Description: \_\_\_\_\_

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☐ Trees # \_\_\_\_\_ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: \_\_\_\_\_

**Findings:**

- ☐ a. The dam crest was not inspected.
- ☒ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☒ e. Access along the crest was satisfactory.
- ☐ f. Access along the crest was not possible. Description: \_\_\_\_\_
- ☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: \_\_\_\_\_
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☒ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ l. \_\_\_\_\_



**7. Downstream Slope:**

(Typical Slope  $\pm$  3/4 : 1)

Access: ☒ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☐ None Observed  
Slope Protection: ☒ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete  
Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed

Description: \_\_\_\_\_

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed

Description: \_\_\_\_\_

Sinkholes: ☐ \_\_\_\_\_ in. Wide x \_\_\_\_\_ in. Long x \_\_\_\_\_ in. Deep ☒ Not Visible ☐ None Observed

Description: \_\_\_\_\_

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # \_\_\_\_\_ ☐ <6" ☒ >6" & <20" ☐ >20"

Description: \_\_\_\_\_

**Seepage: Seep Spot Number 1**

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: \_\_\_\_\_

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_

Description: \_\_\_\_\_

**Seep Spot Number 2**

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: \_\_\_\_\_

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_

Description: \_\_\_\_\_

**Findings:**

- ☐ a. The downstream slope was not inspected.
- ☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The downstream slope appeared to be in fair to poor condition and requires corrective action. **HEAVY OVERGROWTH, TREES**
- ☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☐ e. Slope protection needs maintenance or repair. Description: \_\_\_\_\_
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: \_\_\_\_\_
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☒ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☒ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☒ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.
- ☐ k. \_\_\_\_\_



**8. Abutments/Toe:**

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed  
Description: \_\_\_\_\_

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed  
Description: \_\_\_\_\_

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # \_\_\_\_\_ ☐ <6" ☒ >6" & <20" ☐ >20"  
Description: \_\_\_\_\_

Seepage: Seep Spot Number 1  
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed  
☐ Flowing, Description: \_\_\_\_\_  
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_  
Description: \_\_\_\_\_

Seep Spot Number 2  
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed  
☐ Flowing, Description: \_\_\_\_\_  
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_  
Description: \_\_\_\_\_

**Findings:**

- ☐ a. The abutments/toe were not inspected.
- ☐ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action (*HEAVY GROWTH*)
- ☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☐ e. Slope protection needs maintenance or repair. Description: \_\_\_\_\_
- ☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair.  
Description: \_\_\_\_\_
- ☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☒ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☒ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ l. \_\_\_\_\_

Dam ID: MA-0054

HORNER RESERVOIR

Inspection No: \_\_\_\_\_

Date: 4/4/06

**9. Outlet Works:**

Culvert / Pipe

Type / Size: 12" DIAMETER (SIPHON CONDITION)

Culvert: ☐ Concrete ☐ Masonry ☐ unlined earth ☐ Other \_\_\_\_\_

Pipe: ☐ DIP ☐ Corrugated Metal ☒ PVC ☐ HDPE ☐ Concrete ☐ Other \_\_\_\_\_

Control Type: ☐ Gate ☒ Valve ☐ Other \_\_\_\_\_

Location: ☐ Control on Upstream side ☒ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: \_\_\_\_\_

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: \_\_\_\_\_

Description: \_\_\_\_\_

**Findings:**

- ☐ a. The outlet works were not inspected.
- ☐ b. The outlet works were not tested.
- ☒ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The outlet works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.
- ☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. \_\_\_\_\_
- ☐ j. \_\_\_\_\_

**10. Spillway:**

Type: ☐ None ☐ Culvert/Pipe ☒ Channel  
Description: \_\_\_\_\_  
Dimension: 7 ft. Invert elevation: \_\_\_\_\_ ft. per staff gage  
Slope Protection: ☒ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Concrete  
☐ Defect in Protection: Description: \_\_\_\_\_  
Approach: ☒ Clear ☐ High Veg. ☐ Trees ☐ Other: \_\_\_\_\_  
Erosion: ☐ Scour ☐ Gully ☐ Headcut ☒ Not Observed ☐ Other: \_\_\_\_\_  
Description: \_\_\_\_\_  
Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # \_\_\_\_\_ ☐ <6" ☐ >6" & <20" ☐ >20"  
Description: \_\_\_\_\_

**Findings:**

- ☒ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.  
☐ b. The Spillway appeared to be in fair to poor condition and requires corrective action.  
☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

**Corrective Actions:**

- ☐ d. Slope protection needs maintenance or repair. Description: \_\_\_\_\_  
☐ e. The spillway approach was blocked. Clear approach.  
☐ f. Severe scour erosion was observed which requires maintenance and/or repair.  
Description: \_\_\_\_\_  
☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.  
☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.  
☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.  
☐ j. \_\_\_\_\_

**11. Down Stream Channel:**

Name: NONE  
Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☒ Defined Drainage-way ☐ Other \_\_\_\_\_  
Items along Stream Bank: ☐ None ☐ Road ☐ Houses ☐ Town ☒ Not Inspected  
Description: \_\_\_\_\_

**Findings:**

- ☒ a. The downstream channel was not inspected. (NOT ACCESSIBLE)  
☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.  
☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.  
☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

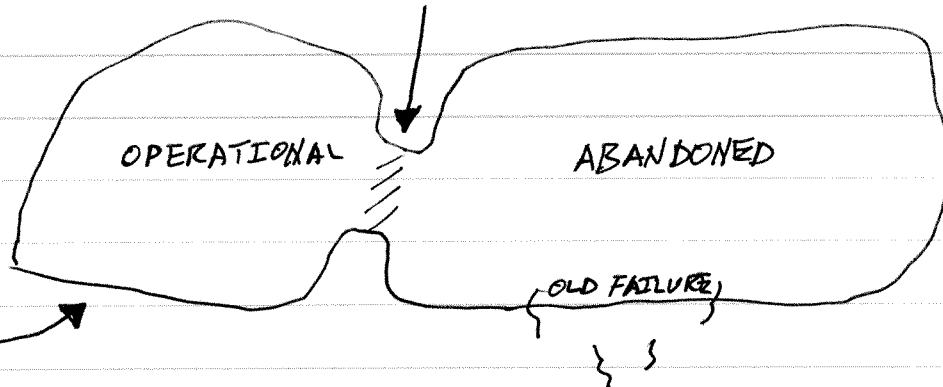
**Corrective Actions:**

- ☐ e. \_\_\_\_\_

**Additional Comments:**

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

- 1) BASED ON VISUAL OBSERVATIONS AND DISCUSSION OF OPERATIONAL PROCEDURES OF THE DAM, THERE IS NO IMMEDIATE THREAT TO THE SAFETY OF THE DAM AT THIS TIME.
- 2) HEAVY GROWTH NEEDS TO BE REMOVED TO PROMOTE VISUAL INSPECTION OF SLOPES.
- 3) 1/2 OF RESERVOIR WAS CUTOFF BY PLACING BERM (WITH BULLDOZER) AFTER FAILURE OF CONDUIT IN 1989. INTEGRITY OF BERM APPEARS SATISFACTORY BUT SHOULD BE FURTHER EVALUATED.

**Limitations and Intent of this Dam Safety Inspection:**

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statutes Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.